Journal of the Kansas Entomological Society

(Central States Entomological Society)

Vol. 24 July, 1951 Number 3

PUBLICATION COMMITTEE

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1889-1929

Entered as second-class matter June 7, 1939 at the Post Office at Manhattan, Kansas, under the Act of August 24, 1912.

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY

A quarterly journal published in January, April, July, and October devoted to Entomology in the Western Mississippi Basin and the proceedings of the Kansas Entomological Society.

Manuscripts for publication may be sent to any of the publication committee.

The Kansas Entomological Society does not make exchanges since the Society does not maintain a library.

Subscriptions to the Journal must be paid in advance. The subscription rate is so low that second notices are not ordinarily sent out.

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Canadian or foreign subscriptions,	**$2.25 per year**	**75 cents**

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Vol. 24, No. 3, July, 1951

This issue mailed July 23, 1951

Kansas Entomological Society
Vol. 24 July, 1951 Number 3

A MONOGRAPHIC STUDY OF THE AFRICAN BIBIONIDAE (Diptera)

Part II: Genus *Philia* Meigen

D. Elmo Hardy
University of Hawaii

(Continued from April, 1951)

Philia disagra Speiser

Philia disagra Speiser, 1910, Sjostedts Kilimandjaro-Meru Exped., 10:39-40.

This species is related to *Philia lucida* n. sp., and is distinguished by the very weak or absent stigmata, the pale halteres, the slightly shorter costa and by the shorter more pale colored head of the female and by differences in body coloration.

The following notes on the male are from the original description. The description of the female is based upon a topotypic specimen in alcohol which Dr. Rene Malaise kindly loaned the writer for study.

Male. Head: Somewhat longer than wide. The antennae and palpi are black with fine chiefly yellow pile. The rostrum is pale yellow with black bristles. The third antennal segment is wider than the other segments. *Thorax*: Shining black on the dorsum, the humeri are reddish yellow and the pleura are grayish rufous. The thoracic pile is fine yellow-white. The teeth of the thoracic combs are reddish. The halteres are yellowish white. *Legs*: The coxae and femora are reddish yellow, paler on the hind legs. The trochanters are blackish brown, the tibiae and tarsi are pitch black. The pile of the legs is whitish yellow. The front coxae are developed into a sharp corner below. The front femora are spindle shaped and thickened. The front tibiae each have four spines in the middle and eight spines at the apex. *Wings*: Yellowish brown, with the stigmata very faint and indistinct. The wing veins are yellow-brown, paler in the hind portion of the wing. The r-m crossvein is a little shorter than the section of media from the crossvein to the fork. *Abdomen*: Black, with yellowish white pile.

Length: body, 3.75 mm.-4.25 mm.

Female. Head: As wide as long and entirely reddish to yellowish brown in color. Antennae ten segmented, yellowish in color. *Thorax*: Chiefly yellowish red. Mesonotum black only at bases of the combs, with no black median stripe. Scutellum dark brown to black, with numerous pale fine hairs on the hind margin. *Legs*: Chiefly yellow-red, except for the brownish red to blackish front tibiae. Front tibiae each with four strong spines in a straight row, situated slightly above the middle of the segment. Apical spurs about equal to the spines in size. *Wings*: Very faintly fumose, all veins very pale yellowish. Stigmata not differentiated from the wing membrane. The costa extends about one-third the distance between the tips of R_s and M_1. Vein M_{3+4} complete, reaching the wing margin. *Abdomen*: Entirely reddish yellow, pale haired.

Length: body, 4.2 mm.; wings, 4.5 mm.
Type locality: Kilimandjaro, Meru.
Type in the Naturhistoriska Riksmuseum, Stockholm.

Philia erythraea (Bezzi)
(Fig. 5a)

Dilophus erythraeus Bezzi, 1905, Firence Boll. Soc. Ent. Ital., 37:205-206.

This species is readily distinguished from all the known African *Philia* by the very pale anterior veins of the wing and by the short costa and the yellowish to white halteres. *Philia disagra* Speiser is apparently a related species but it has the wings yellowish brown fumose.

Male. Small, chiefly polished black, all pile pale except on the eyes. *Head*: Eyes densely covered with short brown pile. Face very short, just slightly developed beyond the eye margin and not produced beyond bases of antennae. Antennae ten segmented, the segments rather closely joined. *Thorax*: Scutellum bare. Mesonotum very highly polished black and chiefly bare, with only fine, short dorsocentral and marginal hairs present. Pleura dark reddish brown, bare except for a few pale hairs on the upper margin. Teeth of thoracic combs small and red. The teeth of the posterior comb are arranged in a 'U' shape, as seen from above, with three small teeth on each side extending part way down the mesonotum in the dorsocentral rows. Halteres yellowish to dirty white. *Legs*: Front tibiae with two sets of spines, one set composed of four rather large spines in an oblique row is located near the middle of the tibiae; the apical set has nine sharply pointed spines. The hind legs are slender, the femora are slightly swollen and the tibiae are almost parallel sided. The hind tarsi are slender, the basitarsi are about eight times longer than wide and two times longer than the second subsegments. The coxae, trochanters and femora are usually dark reddish brown, those of the anterior legs, however, are often chiefly reddish and the posterior two pairs are often tinged with yellow. The tibiae and tarsi vary from reddish brown to black. *Wings*: Entirely hyaline, stigmata not colored. Costa varying from faintly yellow to light brownish yellow and ending at or near the apex of the R_5. The anterior veins are yellowish to whitish and the posteriors are not at all colored and scarcely visible except in some lights. *Abdomen*: Black with a slightly reddish brown tinge, equal to slightly shorter than the combined lengths of the head and thorax. *Genitalia*: Ninth tergum two times longer than wide, the hind margin is straight. Ninth sternum with a very shallow concavity on the hind margin. Claspers short and thick, pointed at apices (fig. 5a).

Length: body, 3.5 mm.-4.0 mm.; wings, 3.0 mm.-4.2 mm.

Female. *Head*: Just slightly longer than wide from a dorsal view. The rostrum is extended only a distance equal to about one-third of the eye length and not at all produced beyond the bases of antennae. Ocelli not on a distinct tubercle and situated near hind margin of head. *Thorax*: Pleura and sides of notum bright yellow-red, in some specimens the entire mesonotum is also rufous. Notum usually with a broad shining black stripe extending down the middle, in some specimens this is reduced to just a spot between the combs, in others it varies all the way up to a complete line which reaches the scu-

tellum. Scutellum and metanotum black. Teeth of posterior comb of thorax not extending down the mesonotum as in male. *Legs*: Coxae, trochanters and femora rufous, the latter with brown to black apices. Tibiae and tarsi black, the spines of the front tibiae are stronger than in the male. *Wings*: Stigmata light brown. The anterior veins are sometimes very faintly brownish. Otherwise like the male, except for genital characters.

Length: body, 3.5 mm.-4.5 mm.; wings, 3.7 mm.-4.7 mm.

Type locality: Adi Caieh, Eritrea.

Type in the Museo Civico di Storia Naturale.

This species appears to be rather common throughout much of Africa; the writer has identified it from the following localities: Estcourt, Natal, Sept.-Oct. 1896 (G. A. K. Marshall); East Africa, New Langenburg, Tanganyika Terr., June 1919 (H. S. Stannus). Mt. Chirinda, Mashonaland, 3800 ft., 12.6.11 (C. F. M. Swynnerton); Orange F. States, Harrismith, March 1-20, 1927 (R. E. Turner); Heath Zone, Kenya, Mt. Elgon, 10,500-11,500 ft., Feb. 1935 (F. W. Edwards); S. Africa, Transvaal April, 1932 (L. Trichwardt); S. Rhodesia, Mt. Chirinda, 3,800 ft., 1910-1911 (C.F.M. Swynnerton); Brit. E. Afr., Kabete, June 1914 (R. H. Deakin). Kilembe, Uganda, Ruwenzori Range, 4,500 ft., Dec. 1934-Jan. 1935 (F. W. Edwards); Fort Portal, Uganda, Ruwenzori Range, Dec. 4, 1934 (F. W. Edwards); W. Darfur, S. Jebel Murra, Kallikitting, 4,450 ft., June 2, 1932 (M. Steele); British E. Africa, Gelegele River, June 1913 (A. O. Luckman); Port St. John, Pondoland, May 1924 (R. E. Turner); Nyasaland, Limbe, Sept., 1916 (R. C. Wood); Yemen, Arabia, from cultivated fields, Usaifira, 1 mi. north of Ta'izz, ca. 4,500 ft., Dec. 13, 1937 (H. Scott and E. B. Britton); Yemen, San'a, ca, 7,500 ft., Feb. 26, 1938, from Lucerne fields N. of city (H. Scott and E. B. Britton); Kauletel-Asakeir, N. E. of Haz, about 16 miles N.W. of San'a, ca, 9,400 ft., Feb. 4, 1938 (H. Scott and E. B. Britton) and Rutshuru, Belgian Congo, Jan. to Dec. 1937 (J. Ghesquiere). Duda also recorded this species from Yemen, Arabia.

Philia femorata (Meigen)

Dilophus femoratus Meigen, 1804, Klass., 1:116.
Dilophus maderae Wollaston, 1858, Annal. Mag. Nat. Hist., Ser. 3, 1:113.

This is a very widespread species that ranges over most of Europe, Asia and North Africa. It is related to *Philia antipedalis* (Wied.) and is distinguished by the slightly to distinctly milky-white wings, the small, indistinct or lacking stigmata, the colorless posterior veins in the wing and by the shorter pile on the hind metatarsi.

The specimens which the writer has seen from Africa differ slightly from the typical *femorata* in that the wings are less milky and the stigmata are brown, otherwise they agree with specimens from Europe.

Following are the important characters for this species.

Male. Entirely shining black, pile of thorax, abdomen and legs yellowish, that of eyes brown to black. Front tibiae each with a slightly oblique row of four strong spines in the middle. Pile of hind metatarsi about equal in length to the width of the segment. *Wings*: Faintly to distinctly milky-white. Stigmata usually lacking, it may be faint or distinct brown in some specimens but is always small in size. The anterior veins are dark brown, the posteriors are

colorless. The costa extends almost one-half the distance from the tip of vein R_5 to the tip of M_1. *Genitalia*: The ninth tergum is about one and one-half times wider than long and its hind margin is straight or nearly so. The ninth sternum is cleft about one-third its length on the hind margin. The claspers are rounded, obtuse at apices.

Female. Chiefly black, except for the sides of the prothorax, the coxae and femora and in some specimens the sides of the mesonotum, which are reddish yellow. The middle and hind coxae and femora are often discolored with brownish at least on their apices. The head is about as wide as long, the front is finely rugose but quite highly polished. The stigmata are distinct and brown in color.

Length: body and wings, 4.0-5.0 mm.

Type locality: Europe.

Type lost.

The species has been recorded from numerous localities in North Africa, as well as from the Canary and Madeira Islands. Wollaston's *maderae* is evidently a synonym of *femoratus*.

The writer has recorded the species from Kenya, in the report of the Ruwenzori Expedition and has also identified it from Abyssinia, Mt. Chillalo Pass, between Digalla and Hotosa. Circa 10,000 -11,000 ft., on flowers of *Dipsacus pinnatifidis*, Nov. 1926 (H. Scott).

Philia hiemalis (Becker)

Dilophus hiemalis Becker, 1908, Mitt. Zool. Mus. Berl., 4:59.

This species is related to *Philia africana* (Becker) and is distinguished by the small, poorly developed, spines in the first set on each front tibia, which are situated well beyond the base of the segment and by the strongly swollen hind tibiae and metatarsi.

The following notes are from Duda[5].

Male. Entirely black species. *Head*: Black, with fine black pile. Eyes with yellowish hairs. Rostrum produced about as long as the head. Antennae black, inserted right in front of the eyes. The antennae are ten segmented and thick, each segment is much wider than long. *Thorax* and *abdomen*: Polished black, with fine pale yellow pile. Halteres yellow. *Legs*: Front tibiae each with two sets of two very small, poorly developed, spines above the apical set; the first set is near the basal third of the tibia and the second is near the middle. Hind tibiae enlarged at apices, slightly wider than the femora at their greatest width. Hind metatarsi unusually thick and swollen, slightly wider than apices of tibiae and only about two times longer than wide. *Wings*: Hyaline, stigmata brown. Anterior veins brownish black, posteriors colorless.

Length: body, 3.5 mm.-4.0 mm.

Female. Rostrum as long as the eyes. Antennae inserted at the basal two-thirds of the rostrum. Thorax black except for the reddish yellow propleura. Spines of the front tibiae larger, more strongly developed than in the male. Hind tarsi less enlarged than in male and all tarsi slender. Front femora yellowish brown, much more thickened than in the male.

[5] Die Fliegen der Pal. Reg., 2(4):32.

Type locality: Canary Islands.
Type in Zoologisches Museum der Universitat Berlin.
The writer has not seen this species.

Philia lingens (Loew)

(Figs. 6a-b)

Dilophus lingens Loew, 1869, Syst. Beschr. der Bek. Europ. Zweifl. Insekten, Suppl. 1:20.
Dilophus clavipes Lundström. This was apparently a cabinet name of Lundström's in the Hungarian National Museum. Duda published it as a synonym of *lingens*, 1930, Die Flieg. der Pal. Reg., 2(4):33.

This species is distinguished from the other *Philia* which have three sets of spines on the front tibiae, by having three spines in the middle set, by having the hind metatarsi strongly swollen and the rostrum greatly elongated.

The following notes and the figures were taken from Duda[6] and from Lundström[7].

Male. Head: Black with black pile. Rostrum elongated, produced about as long as one eye. *Thorax*: Polished black and black pilose. Scutellum with long black pile on hind margin. Halteres black with brown stems. *Legs*: Chiefly black, hind tibiae and tarsi brownish. Front tibiae with two sets of strong spines above the apical set. The first set has two large spines and is located at the basal one-third of the tibia. The second set contains three spines and is situated slightly beyond the middle of the tibia, near the apical two-thirds. Hind femora rather slender; hind tibiae strongly thickened at apex, much wider than the greatest width of the femora. Tarsal subsegments swollen, rather oval in shape; the basitarsi are about equal in width to the apices of the tibiae (fig. 6a). *Wings*: Hyaline, somewhat milky with slightly colored anterior veins and colorless posterior veins and stigmata. *Abdomen*: Polished black, covered with black pile. *Genitalia*: Ninth tergum apparently about two times wider than long, the hind margin is straight or nearly so. The claspers are short and thick, rounded at apices (fig. 6b).

Length: body, 3.5-4.0 mm.

Female. Rostrum a little longer than in the male, about three-fourths as long as the head and longer than the eyes. Thorax chiefly reddish brown, black in the central portion and on the sides of pronotum. Front femora yellowish brown. Middle femora blackened only on the underside of the apices. Hind pair black on the apical two-thirds. Front tibiae yellowish brown, the other tibiae chiefly black. The tarsi are chiefly black, the metatarsi are yellowish. Otherwise like the male, except for genital characters.

Type locality: "Rhodes."

Type probably in Zoologisches Museum der Universitat Berlin.

Duda has recorded the species from Tunisia. The writer has not seen this species.

Philia lucida Hardy

Philia lucida Hardy, 1948, Brit, Mus (Nat. Hist.), Ruwenzori Exped., 1934-1935, 1(6):125-126.

This species is related to *Philia erythraea* (Bezzi) and to *disagra* Speiser. It is separated by the characters given in the key. The elongate costa and the

[6] 1930, Die Flieg, der Pal. Reg., 2 (4):33-34.
[7] 1913, Ann. Mus. Nat. Hung., 11:390.

black halteres will distinguish it from *erythraea*. The black halteres, brown stigma and the differences in the shape and coloration of the female head will distinguish it from *disagra*. The writer has no further information to add to the original description.

Length: body, 4.0 mm.; wings, 4.6 mm.

Type locality: Mt. Sabino, Kigezi Dist., Uganda.

Type in the British Museum (Natural History).

Philia nupta Speiser

(Figs. 7a-f)

Philia nupta Speiser, 1914, Berl. Seits. Deutsch. Ent. Ges.:1.

This species is very well defined by the elongate body, the strongly swollen hind tarsi and by the arrangement of the spines on the front tibiae.

Male. *Head*: Eyes bare, remainder of head with black pile. Rostrum produced distinctly beyond the eye margins but not beyond bases of antennae. Antennae long and slender, about as long as the head, and with thirteen distinct segments. *Thorax*: Chiefly polished black with sparse black pile. Humeral ridges, propleura and portion of thorax at each side of scutellum yellowish, pleura otherwise brownish red to blackish. Halteres black. *Legs*: Coxae, trochanters and femora chiefly brownish yellow, these segments of the front legs more bright yellow-red. Tibiae brownish, with a yellowish tinge. The tarsi are black. All pile of legs black. The front tibiae have two spines near the bases and one large spine near middle (in the typical specimens) besides the apical row of eight to nine spines. (fig. 7a). There is considerable variation in the size and arrangement of the middle spines on the front tibiae, in some specimens a tiny spine is developed inside the large median spine (fig. 7b). In others there are two, approximately equal, spines in the middle of each front tibia (fig. 7c). Hind tibiae strongly swollen at apices, much thicker and shorter than the slender femora. Hind tarsal subsegments strongly swollen, the basitarsi are about two and one-half times longer than wide (fig. 7d) and about equal in length to the next three subsegments. *Wings*: Brownish fumose, darker along costal margin. The stigmata and anterior veins are dark brown, the posteriors are pale yellowish brown. The costa extends almost half way from the tip of R_s to the tip of M_1. The fork of veins M_1 and M_2 lies just slightly beyond the m crossvein. *Abdomen*: Entirely black, with all black pile; rather long and slender, distinctly longer than the head and thorax combined. *Genitalia*: Ninth tergum about two times wider than long, hind margin straight (fig. 7e). Ninth sternum with a large membranous mound in the middle. Claspers large, broad and square at apices, slightly pointed below (fig. 7f).

Length: body, 5.0 mm.-6.0 mm.; wings, 4.6 mm.-5.2 mm.

Female. *Head*: Polished black, very lightly pruinose, nearly two times longer than wide from a dorsal view. From a lateral view the eyes are centrally located, the rostrum as well as that portion of head behind eyes is not quite equal to the length of one eye. Ocellar tubercle situated near the hind margin of the head and not strongly raised. Scape and pedicel of antennae yellowish red, pronotum sometimes brownish between combs. Mesonotum varying from bright yellow-red to shining black. Scutellum and meso- and

metapleura reddish brown to blackish. *Legs*: Front coxae and all femora yellow. Tibiae chiefly yellow, with brownish apices and red spines; tarsi brown to black. Spines of front tibiae larger and more developed than in the male, only a single spine at the middle of each tibia in all specimens studied. Hind tibiae not enlarged, narrower than the femora. Hind tarsi not swollen. *Abdomen*: Black to yellowish brown. Otherwise like the male.

Length: body, 4.5 mm.-5.0 mm.; wings, 5.0 mm.-5.5 mm.

Type locality: Dschang, Cameroons.

Type possibly in the Naturhistoriska Riksmuseum, Stockholm.

The writer has studied specimens from the following localities: Obuasi, Ashanti, W. Africa, July 28-Aug. 16, 1907 (W. M. Graham); N. Rhodesia, Serenje, Chitambo, 4,950 ft. 1928 (H. F. Wilson); Nyasaland, Mlanje Plateau, 6,500 ft., Nov. 12-14, 1913 (S. A. Neave); Uganda, Ruwenzori Range, Kilembe, 4,500 ft., Dec. 1934-Jan. 1935 (F. W. Edwards); Uganda forest, Kawanda, June 17, 1943 (T. H. C. Taylor); W. Uganda, Bwamba Country, 1938 (J. O. Harper); Embu, Brit. E. Afr., 18, 12, 13; Teita Hills, Kenya, Aug. 1947 (Van Someren); Rutshuru, Belgian Congo, Dec. 3-6, 1937 (J. Ghesquiere) and Nyassa-See Mbamba-Bai, April 12-16, 1936 (Zerny).

Philia obsoleta n. sp.

(Figs. 8a-b.)

This species is related to *Philia erythraea* (Bezzi) and *P. lucida* Hardy. It is distinguished from *erythraea* by the more elongate costa, the darker halteres, the chiefly blackish legs, more oblong shape of female head and by the differences in the male genitalia. It separates from *lucida* by having vein M_{3+4} incomplete, by the paler halteres, by the concave hind margin of the ninth tergum of male and the square tipped claspers.

Male. Chiefly shining black, with all pile pale yellowish and rather elongate, except for the short brown pilosity of the eyes. *Head*: Rostrum very short, developed just slightly beyond the eye margins and not at all beyond antennal bases. Antennae ten segmented, rather short and robust, the segments of the flagellum are very compact. *Thorax*: Dorsocentral and marginal hairs rather well developed. Humeral ridges faintly yellowish at the sides. Metanotal combs black, with a faint reddish tinge. Halteres chiefly yellow, the knobs slightly discolored with brownish. *Legs*: Mostly shining black, femora with a faint reddish tinge; tibial spurs all black. Front tibiae each with one set of four blunt spines arranged in an oblique row at the middle. The apical set of spines has eight rather short and blunt teeth in addition to the undifferentiated tibial spur. Tibiae and tarsi very slender, not at all swollen. Femora and tibiae with an abundance of long pale pile. *Wings*: Entirely hyaline, stigmata lacking. Anterior veins whitish, the apical half of the costa is slightly brownish yellow. The posterior veins are entirely colorless. The costa extends about one-third the distance between the tips of R_5 and M_1. The fork of veins M_1 and $_2$ is just slightly beyond the m crossvein. Vein M_{3+4} and the anal vein ending well before the wing margin. *Abdomen*: Rather short and robust, about equal in length to the thorax and thickly pilose. *Genitalia*: Ninth tergum about one and one-half times wider than long, its hind margin gently concave (fig. 8a). Ninth sternum about as wide as long, cleft about

one-fourth its length on the hind margin. Claspers simple, blunt at apices and rather square tipped (fig. 8b).

Length: body, 4.5 mm.; wings, 3.5 mm.-4.0 mm.

Female. Head: Slightly longer than wide, from dorsal view. Rostrum one-third to one-fourth as long as one eye and not produced beyond antennal bases. Scape and pedicel bright yellow. Ocellar tubercle not well developed and situated at the hind margin of the head. *Thorax*: Chiefly reddish yellow, the dorsum has a brown to black stripe which extends between the pronotal combs, two-thirds the length of the mesonotum. All of the metanotum and the top side of the scutellum are brownish to black and the sternum is tinged with brown. *Legs*: The coxae, trochanters and femora are bright yellowish red. *Wings*: The stigmata are pale brown and the anterior veins are faintly yellowish. Some specimens have the anterior veins slightly brownish tinged. *Abdomen*: Brown above, yellowish on the venter. Otherwise like the male, except for genital characters.

Length: body, 3.5 mm.-4.5 mm.; wings, 4.0 mm.-4.7 mm.

Holotype male: Van Reenen, Drakensberg, Natal, Nov. 1926 (R. E. Turner). Allotype female and seven paratypes, two males, five females, same data as type. Three paratype females from the following localities: Zomba, Nyasaland, Feb. 1911 (J. E. S. Old); m'Fongosi, Zululand, Apr.-May 1934 (W. E. Jones) and Somerset East, Cape Prov., Oct. 1930 (R. E. Turner).

The holotype, allotype and six paratypes have been returned to the British Museum. One paratype has been returned to the South African Museum. Two have been deposited in the U. S. National Museum and one is in the B. P. Bishop Museum collection, Honolulu, T.H.

Philia splendens n. sp.

(Fig. 9a)

This species is related to *Philia bicolor* (Wiedemann). It is distinguished by its all black pile; by the entirely rufous thorax, and black abdomen of the female; by the shorter costa and not so elongated rostrum.

Male. Entirely black, except for pale humeral ridges. Pile all black. *Head*: Eyes very sparsely pilose. Rostrum noticeably produced beyond eye margins but not beyond bases of antennae. Antennae apparently ten segmented, the last two are very closely joined. *Legs*: Front tibiae each with an oblique row of four spines near the middle. The apical set possesses nine spines. Hind tibiae slender, much thinner than femora and about equal to them in length. Hind tarsal subsegments slender, eight times longer than wide and equal in length to the next three subsegments. *Wings*: Rather dark brown fumose, stigmata slightly darker than the membrane. Posterior veins brown but not quite as dark as the anteriors. Costa extending well beyond the tip of R_5, about one-fourth of the distance to the tip of M_1. Halteres black. The genitalia have not been studied.

Length: body, 6.0 mm.; wings, 5.0 mm.

Female. Head: About two times longer than wide from a dorsal view. Rostrum about equal to the eye length but not strongly developed beyond bases of antennae (fig. 9a). Antennae eleven segmented. Front rather coarsely rugulose. Ocellar tubercle not at all prominent, situated near the hind portion

of the head. *Thorax*: Entirely bright red, except for the black teeth of the combs. Halteres black. *Legs*: Coxae, trochanters and femora bright yellow-red. Tibiae and tarsi black. Spines of front tibiae larger than in the male. *Wings*: Slightly darker brown, stigmata scarcely differentiated from the membrane. Otherwise like the male.

Length: body, 6.5 mm.-7.0 mm.; wings, 6.6 mm.-7.2 mm.

Holotype male and allotype female on same pin: Cape Province, Somerset East, Nov. 25-30, 1930 (R. E. Turner). Five paratype females, same data as type.

Holotype, allotype and three paratypes returned to the British Museum. One paratype deposited in the United States National Museum and one in the B. P. Bishop Museum, Honolulu, T.H.

Philia suberythrea (Edwards)

(Figs. 10a-b)

Dilophus suberythreus Edwards, 1915, Voy. Alluaud. Dipt., p. 62.

This species appears to be most closely related to *Philia capensis* (Edwards). It is distinguished by the slightly infuscated wings and colored posterior veins; also by the more extensively rufous thorax, by the dark tipped femora and the yellowish venter of the female.

Male. Chiefly shining black species. Pile all yellowish to whitish, except for the brown pile on the eyes. *Head*: Eyes with very short, sparse pile. Rostrum well developed, distinctly produced beyond bases of antennae and over one-half as long as the lower section of each eye. Antennae ten to eleven segmented, the apical three segments are closely joined. Pedical yellowish, the remainder of antennae black. The compound eyes are rather elongated, from a dorsal view they are distinctly longer than wide. *Thorax*: Dorsum brightly polished black and nearly bare except for dorsocentral and marginal hairs. Pleura with a distinct reddish brown tinge, bare except for a few hairs on upper margin. Knobs of halteres black, stems pale. *Legs*: Coxae, trochanters and femora dark reddish brown, tibidae and tarsi black. Front tibiae each with two sets of spines. The median set has four strong blackish teeth in an oblique row (fig. 10a) and the apical set possesses nine teeth. Hind femora moderately swollen, tibiae scarcely enlarged apically and about equal in length to the femora. Posterior basitarsi about six times longer than wide and about equal in length to the next subsegments. Pile of tarsi short, scarcely longer than the width of the tarsi. *Wings*: Very faintly infuscated, stigmata and anterior veins brown, posteriors faintly yellowed. The portion of vein M_{1+2} between the forking of the veins and the m crossvein is usually about equal in length to the crossvein. *Abdomen*: Equal to slightly longer than the head and thorax combined. *Genitalia*: Ninth tergum about three-fourths as long as wide, hind margin straight. Ninth sternum with a "U" shaped concavity extending about one-third of its length. Claspers short and thick, rounded apically (fig. 10b).

Length: body and wings, 3.5-4.0 mm.

Female. *Head*: From a dorsal view the head is nearly three times longer than wide. The eyes are about median in position, the sclerotized portion of the face in front of the eyes, as well as that part of head behind eyes, is equal

in length to the eyes. Rostrum distinctly developed beyond antennal bases. Ocellar tubercle weak, located near back of head. *Thorax*: Pleura and sides of notum yellow-red. Dorsum with a broad black stripe extending the entire length of the thorax. Scutellum and metanotum black. *Legs*: Coxae and femora reddish yellow, femora dark brown to black at the tips. Tibiae and tarsi black. Tibial spines larger, slightly more blunt than in the males. *Abdomen*: Black on the dorsum, yellowish brown on the venter. Otherwise as the male, except for genital characters.

Length: 3.4 mm.-5.0 mm.; wings, 3.8 mm.-5.2 mm.

Type locality: Molo, Brit. East Africa.

Type in British Museum (Natural History).

The writer has identified the species from the following localities; Mt. Kinangop, 8,000 ft., Cedar forest, Kenya, Aberdare Range, Oct. 1934 (F. W. Edwards); Nyeri Track, 10,500 ft., Kenya, Aberdare Range, Oct. 1934 (F. W. Edwards); Cholo Mt., 4,000 ft., Dec. 25, 1927 (R. C. Hood) and Banhoek Valley, Stellenbosch Div., Oct. 1934.

Philia tridentata (Walker)

Dilophus tridentatus Walker, 1848, List Diptera Brit. Mus., 1:118.

This species appears to be distinguished from all other known species of *Philia* by having three sets of spines on the front tibiae above the apical set.

The following notes are from the original description.

Body shining black, abdomen dark piceous. Eyes and antennae black. Legs chiefly black, all tarsi and front legs piceous. Each front tibia armed with three double teeth. The wings are hyaline except for the brown stigma and the pale brownish costal cell. The anterior veins are tawny, the posterior are yellow.

Length: body 4.0 mm.; wings, 8.0 mm.

Type locality: Tripoli.

Type in British Museum (Natural History).

The writer has not seen this species.

Philia vicaria Hardy

Philia vicaria Hardy, 1948, Brit. Mus. (Nat. Hist.), Ruwenzori Exped., 1934-1935, 1 (6) :127.

This species is related to *Philia nupta* Speiser and is distinguished by its hyaline wings, slender hind tibiae and tarsi and by the difference in the arrangement and number of spines on the front tibiae. The species is adequately treated in the original description.

Length: body and wings, 5.0 mm.-6.0 mm.

Type locality: Mt. Mgahinga, Kigezi Dist., Uganda.

Type in the British Museum (Natural History).

A NEW GENUS OF WALCHIINAE (ACARINA, TROMBICULIDAE)[1,2]

LOUIS J. LIPOVSKY
Lawrence, Kansas

The subfamily Walchiinae was described by Ewing (1946) on the basis of larval morphology and further characterized by Wharton (1947) on the basis of leg segmentation: Leg I with seven segments, legs II and III with six segments. The genera included in this subfamily are *Gahrliepia* Oudemans, 1912; *Schöngastiella* Hirst, 1915; *Walchia* Ewing, 1931; *Gateria* Ewing, 1938; a new genus, Fuller (in press); and the new genus described below.

Pseudoschöngastia new genus

Diagnosis—This genus differs from the other genera of this subfamily in that only three scutal setae are present, the posterolateral setae being off the scutum. It perhaps is most closely related to *Walchia*; however, *Walchia* lacks the anteromedian seta. Superficially, this genus resembles the "Schöngastia-type" larvae of the Trombiculinae. It may be confused with *Ascoschöngastia* because the femora of legs II and III may appear divided in some specimens.

Description—Three scutal setae, posterolateral setae not on scutum. Sensillae subglobose to globose, globular distal half clothed with triangle scale-like barbs. Distal segments of chelicera blade-like, as in *Walchia*. Palpal claw with middle prong ventral and longest, lateral prongs approximately equal in size. Eyes equally well developed, or posterior eyes poorly developed. Scutum approximately as wide as long; posterolateral margins arcuate; lateral margins nearly straight or emarginate; anterior margin nearly straight or sinuate; surface profoundly sculptured. Empodium claw-like.

Type species—Pseudoschöngastia hungerfordi new species

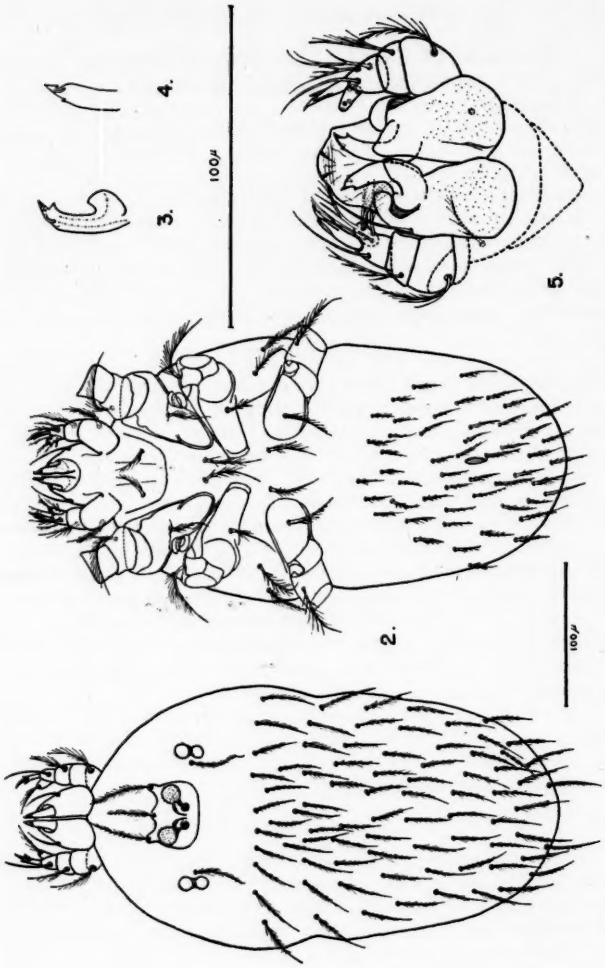
This genus includes, in addition to the type species, *P. farneri*, described below, and according to Wharton (in litt.), *P. diazi* (Hoffmann), described as *Ascoschöngastia diazi* Hoffmann.

Pseudoschöngastia hungerfordi new species

Body—Length and width of smallest specimen, the holotype, 213 by 128 microns; largest specimen in type series 454 by 291 microns. Body widest at level of coxae III, constricted behind this level. Color in life white to pale yellow, occasionally with brownish internal granules. Striae fine, about 1 micron apart in unengorged specimens. Eyes two on each side, bright red in life; ocular plate obscure; distance between anterior margin of anterior eye and posterior margins of posterior eye 18 microns in unengorged specimens, to 31 microns in engorged specimens. Anus situated between the sixth and seventh rows of ventral setae, length about 12 microns.

Gnathosoma—Total length of chelicera about two times the width of basal

[1] The studies upon which this paper is based were conducted under a contract, N6 ori-220 Task Order II between the University of Kansas and the Office of Naval Research.
[2] Contribution No. 774 of the Department of Entomology of the University of Kansas, Lawrence, Kansas.



EXPLANATION OF PLATE
Figure is a composite drawing.

PLATE I
Pseudoschöngastia hungerfordi

Fig. 1. Dorsal aspect of larva.
Fig. 2. Ventral aspect of larva.
Fig. 3. Lateral aspect of distal segment of chelicera.
Fig. 4. Ventral aspect of distal segment of chelicera.
Fig. 5. Dorsal aspect of gnathosoma.

segment; basal segment about a third longer than width at base, puntate; pseudochela large and blunt; distal segment, in lateral view, curved upward at apex with a terminal and an "accessory" tooth each approximately equal in size; ventral margin apically with two retrorse lateral teeth, the subapical short, acute and straight, the other about 3 times as long as the subapical tooth, blunt and curved ventrally; an additional ventral projection is present basad to the curved tooth (Figs. 3 and 4). Seta on palpal coxa feathered, with 6-10 branches; seta on papal femur feathered, with 14-16 branches; genual seta with 5-6 branches; dorsal and lateral tibial setae nude, ventral tibial seta with 3-4 branches. Palpal tarsus with a slender basal spur about 7 microns long and five feathered setae. Galeal seta nude.

Scutum—Posterolateral margins strongly arcuate, posterior margin straight or slightly emarginate; lateral margins may be emarginate; anterior margin sinuate to nearly straight; anterolateral setae longer than anteromedian seta, feathered. Distal portions of sensillae globular, 13-16 microns in diameter and clothed with short barbs 1-2 microns long; proximal portions slender with minute barbs. Surface of scutum finely punctate and profoundly sculptured (Figs. 9 and 10). Posterolateral setae are off the scutum, near eyes.

When the Standard Data are correlated with the degree of engorgement, it is found that AW increases slightly with engorgment even though the measurement is taken on a presumably fixed scutum. The greatest increase is noted in PW and AP as the chigger increases in engorgment. In the type series of *P. hungerfordi*, specimens of maximum engorgement are not included since the largest individuals were selected for culturing.

TABLE I

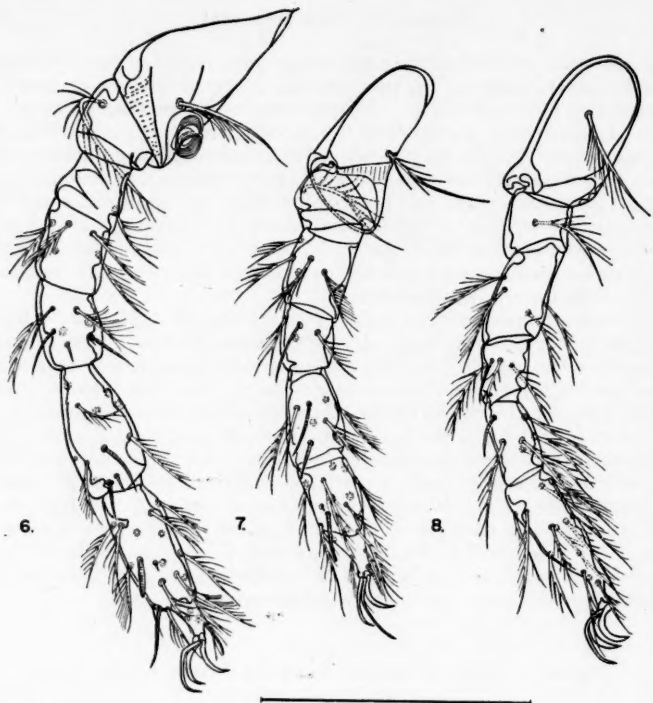
Measurements in microns of *P. hungerfordi* from the type series.

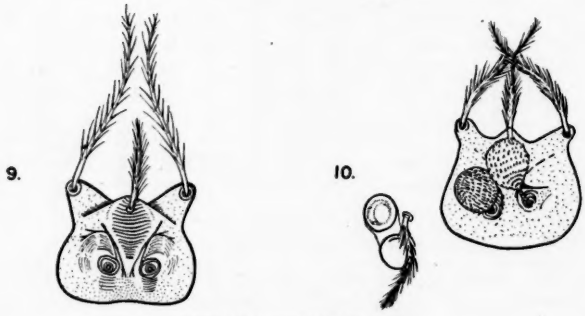
	Slide	Length	Wid.	AW	PW	SB	ASB	PSB	AP	AM	AL	PL
Holotype	6202	213	128	39	55	13	21	15	23	21	35	25
Paratype	6210	269	156	39	64	18	21	11	25	21	—	28
"	6211	298	178	40	70	16	20	13	26	21	33	28
"	6207	327	199	40	75	9	23	14	33	—	39	24
"	6215	362	213	43	75	21	19	11	32	20	43	27
"	6219	390	242	42	74	14	20	16	28	21	39	25
"	6259	440	284	43	85	16	21	13	32	—	33	23

TABLE II

Average measurements in microns of *P. hungerfordi*.

	Slides	Length	Wid.	AW	PW	SB	ASB	PSB	AP	AM	AL	PL
Types	6201-20	356	199	41	71	16	21	13	30	21	38	25
Missouri	6261	426	213	38	67	12	22	11	28	21	35	26
Kansas	6262-66	434	279	39	81	13	24	13	33	24	43	28
Kansas	6267-74	387	234	41	82	12	27	12	33	25	44	28
Texas	6275-78	543	317	42	94	14	28	11	40	29	41	31
Kansas	6279-85	521	357	43	97	14	26	13	40	28	47	30





EXPLANATION OF PLATE

Figure is a composite drawing.

PLATE II

Pseudoschöngastia hungerfordi

Fig. 6. Leg I.
Fig. 7. Leg II.
Fig. 8. Leg III.
Fig. 9. Dorsal plate without sensillae, showing sculpturing.
Fig. 10. Dorsal plate with sensillae, left PL associated with left eyes.

Legs—Leg I coxa with a single branched seta; urstigma uniform, well rounded (Fig. 6); genu with 3 genualae, one microgenuala; tibia with two tibialae, one microtibiala; tarsus with one spur and microspur, one subterminala about one-fourth again as long as spur, one parasubterminala; one pretarsala. Leg II coxa with a single seta with branches arising only on proximal half, one genuala, two tibialae, one spur and microspur, and one pretarsala (Fig. 7). Leg III coxa with a single seta with more branches than coxal setae of legs II or III, with one genuala and a tibiala (Fig. 8). Claws and empodium alike in all legs.

Setae—In general, body setae similar to scutal setae; no definite dorsal or ventral setal arrangement determined for holotype; 28 dorsal setae in first 3 rows, 10 of these considered as humeral setae, total dorsal setal count 80. In holotype two longest, marginal, humeral setae 28 microns long. In engorged specimens these are found ventrally between coxae II and III, (see fig. 2). Dorsal setal arrangement of fig. 1 interpreted as 10-15-10-10-9-9-8-6-2; setae increase in size from middorsal line laterally and posteriorly. Ventral setae of holotype, 2-2 (ventral humeral) -2 plus about 50. Total dorsal and ventral setal count 134. Setal measurements of holotype; anterior dorsal 18 microns, anterior ventral 18 microns, first and second sternal setae 36 and 28 microns respectively.

Type Material—Holotype and 59 paratypes from Douglas County, Kansas, 2 miles south, 4 miles west of Baldwin (U.S. Highway 59), July 14, 1949, on *Sylvilagus floridanus*, cottontail rabbit (Field No. RL490714-2*); holotype, slide number 6202; paratypes, slide numbers 6201 and 6203-6260.

The following additional specimens are referred to this species—Wallace County, Kansas, 3 miles south of Wallace, July 4, 1949, on *Peromyscus maniculatus*, white-footed mouse (RL490704-11,12), slides 6267-6274. Barber County, Kansas: 5 miles south, 4 miles east of Aetna, August 22, 1949, on *Dipodomys ordii*, kangaroo rat (RL490822-6), slides 6262-6266; 4 miles south of Aetna, August 22, 1949, on *Neotoma micropus*, hoary wood rat (RL490822-1), slides 6279-6285. Lawrence County, Missouri, ½ mile southwest of Verona, September 6, 1947, on *Reithrodontomys fulvescens*, harvest mouse (F470906-6), slide 6261. Williamson County, Texas, Liberty Hill, July 10, 1948, on *Neotoma floridana attwateri*, Attwater wood rat, collector R. W. Strandtmann, slides 6275-6278.

Remarks—This species is named for Professor H. B. Hungerford who helped to establish and direct the chigger project and who presented the writer with the opportunity to study chiggers at the University of Kansas.

Biological Notes—The nymphs and adults of *P. hungerfordi* have been reared in the laboratory from engorged larvae obtained from their hosts. The species first appears around Lawrence, Kansas, about the second week of July and becomes common on *Sylvilagus floridanus* during July and August. It is found specifically in the ears. When the host is killed the larval chiggers detach readily.

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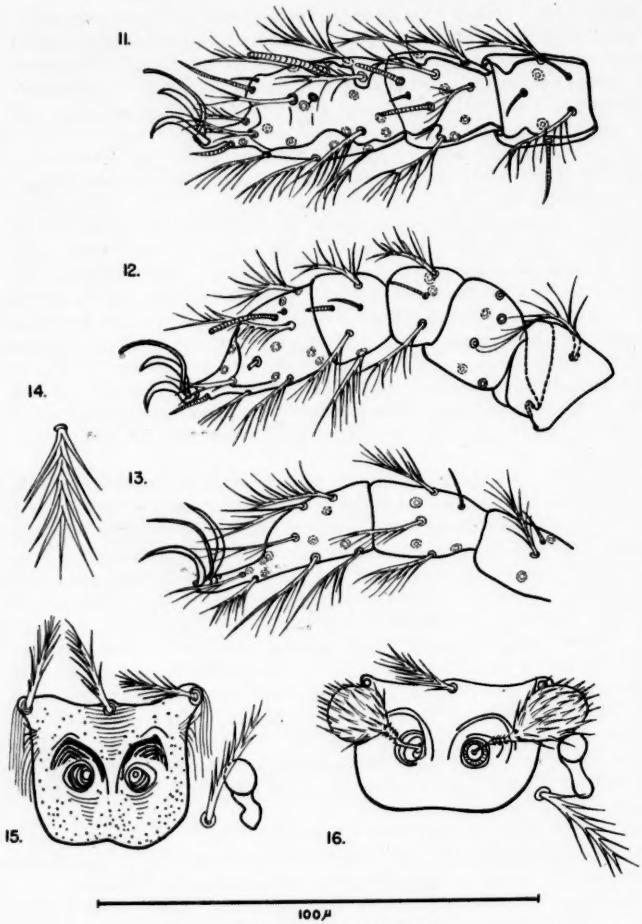
* The letters at the beginning of each field number, usually indicate the person who collected and identified the host; F for Robert B. Finley, L—the author, and RL—Richard B. Loomis. Acknowledgement is made to those listed above for their aid in obtaining the hosts and their chiggers.



EXPLANATION OF PLATE
Figure is a composite drawing.

PLATE III
Pseudoschöngastia farneri

Fig. 11. Genu, tibia and tarsus of Leg I.
Fig. 12. Leg II minus the coxa.
Fig. 13. Genu, tibia and tarsus of leg III.
Fig. 14. Anterior ventral body seta; magnification doubled.
Fig. 15. Dorsal plate without sensillae, showing sculpturing and attachment of dermal striae.
Fig. 16. Dorsal plate with sensillae; right PL associated with right eyes.

Pseudoschöngastia farneri new species

Diagnosis—*P. farneri* can be separated from *P. hungerfordi* by the shorter AL, shorter than or equal to AM. Other differences are listed below.

Body—Color in life white to pale yellow, eyes pink to colorless in some specimens. Length and width of smallest specimens in type series 227 by 142 microns; largest specimen 426 by 277 microns. Two eyes on each side, posterior eyes irregular and considerably smaller than anterior eyes in most specimens. Distance between anterior margin of anterior eye and posterior margin of posterior eye in smallest specimen 12 microns, in largest specimen (not type) 18 microns.

Gnathosoma—Differs from *P. hungerfordi* in having a nude genual seta and a 6-branched dorsal tibial seta. Galeal seta nude.

Legs—In general, leg segments shorter, Leg I with two genualae instead of three as in *P. hungerfordi*.

Scutum—Similar to *P. hungerfordi*, the most obvious difference is in the anterolateral setae which are equal to or shorter than the anteromedian seta. The sensillae are clothed with barbs, the longest being 7 to 8 microns.

Setae—Dorsal setae 73 in holotype (slide 6301), setal formula indefinite but may be listed as 6-8-8-11-11-10-9-5-5. Humeral setae 32, anterior dorsal setae 18, posterior dorsal setae 28 microns in length. Ventral setae 60, setal arrangement 2-2 (humeral)-2-10-13-12-10-8-1. First sternal setae 31, second, 20 microns in length; anterior ventral setae 13, posterior ventral setae 22 microns long.

TABLE III

Measurements in microns of *P. farneri*

	Slide	Length	Wid.	AW	PW	SB	ASB	PSB	AP	AM	AL	PL
Paratype	6302	227	142	41	45	13	18	16	24	23	19	25
"	6305	248	163	41	48	11	18	16	25	18	18	25
"	6312	284	206	44	53	15	21	14	26	21	19	26
"	6313	284	177	39	44	13	18	16	26	19	18	26
"	6310	319	177	43	53	15	16	17	28	19	18	28
Holotype	6301	369	241	41	59	16	21	16	27	20	18	26
Paratype	6314	398	249	43	65	13	20	18	31	18	18	25
"	6315	398	249	41	59	13	20	17	28	20	18	26
"	6306	426	297	39	66	15	20	15	31	21	16	23
Colorado	6331	241	149	38	45	13	18	16	25	23	18	26
"	6322	298	163	38	52	14	17	17	26	17	16	28
"	6323	305	177	43	50	14	21	16	27	21	18	26
"	6327	350	185	37	50	14	18	14	28	20	16	26
"	6332	390	192	38	45	13	18	16	25	23	18	26
"	6328	376	213	39	57	14	18	16	30	—	16	25
"	6329	476	284	45	68	18	17	16	28	21	16	26
"	6325	447	284	43	72	18	18	17	29	21	18	25
"	6321	504	327	36	66	16	18	18	27	21	18	23
Kansas	6339	518	291	40	67	14	17	17	32	22	17	25

TABLE IV

Average Measurements in microns of *P. farneri*

	Slides	Length	Wid.	AW	PW	SB	ASB	PSB	AP	AM	AL	PL
Types	6301-20	366	219	41	56	14	20	16	28	19	18	26
Colorado	6321-33	363	213	40	57	15	18	16	27	21	17	26
Kansas	6334-41	472	269	40	66	14	18	16	33	21	16	24
"	6342	447	284	40	71	14	19	16	34	20	17	23
"	6343-44	490	315	39	66	13	18	15	30	20	16	23

Remarks—Three specimens in the type series show no evidence of AM; one specimen, 6311, duplicated the right AL, both were 21 microns in length whereas the left AL measures 18 microns.

The species is named for Professor Donald S. Farner, one of the original organizers of the chigger project at the University of Kansas.

Biological note—This species is also found specifically in the ears of its hosts.

Type material—Holotype and 19 paratypes from Douglas County, Kansas, 5 miles north, 1 mile east of Lawrence, August 19, 1947, on *Cryptotis parva*, little short-tailed shrew (field no. F470819-5); holotype, slide number 6301; paratypes, slide numbers 6302-20.

The following additional specimens are referred to this species—Boulder County, Colorado, Gregory Canyon, Boulder City Park, August 14, 1947, on *Peromyscus maniculatus*, white-footed mouse (L470814-17), slides 6321-33. Barber County, Kansas: 4 miles south of Aetna, August 22, 1949, on *Neotoma micropus*, hoary wood rat (RL490822-1), slides 6334-41; 3½ miles south, 1 mile west of Aetna, April 13, 1949, on *Peromyscus maniculatus* (RL490413-2), slide 6342; 5 miles south of Sun City, April 12, 1949, on *Peromyscus maniculatus* (RL490422-2), slides 6343-44.

Disposition of types—Holotype and a series of paratypes of *P. hungerfordi* and *P. farneri* are deposited in the Snow Entomological Collections, University of Kansas. Additional paratypes will be distributed to the United States National Museum, the Rocky Mountain Laboratory, the British Museum (Natural History) and the Muséum National d'Histoire Naturelle, Paris, France.

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NEW SPECIES OF DOLICHOPODIDAE IN THE UNIVERSITY OF KANSAS COLLECTION (DIPTERA)

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This report includes descriptions of seven apparently undescribed species of Dolichopodidae which were among material submitted to the writer for identification by Dr. R. H. Beamer, Department of Entomology, University of Kansas. Holotypes and allotypes of the species herein described have been returned to Dr. Beamer, and are deposited in the Snow Entomological collection.

Dolichopus arizonicus n. sp.

Male. Length, 5.5 mm.; length of wing, 5 mm. Face wide, its sides nearly parallel, yet slightly broader immediately below the antennae, yellowish-white on upper portion, the lower portion silvery pollinose. Front dark green, metallic. Palpi silvery pollinose, with two small black bristles on anterior surface near the tip. Proboscis black. Lateral and inferior postorbital cilia yellowish; the upper black cilia descend for about one-third the eye height. Antennae of unusual length for a member of this genus, equaling the length of posterior basitarsus; first two segments black on upper half, yellow below, both segments with dense, bristly hairs on upper surface; third joint black, slightly longer than wide, somewhat conical. Arista thick, densely pubescent, subapical.

Dorsum or thorax dark green, metallic, very lightly dusted with brown pollen, its reflections coppery when viewed obliquely; pleurae heavily dusted with grayish pollen, less shining than the dorsum. Abdomen metallic, green, the lateral portions lightly dusted with white pollen; there is a conspicuous cluster of long, yellow hairs on the sides of the second and third abdominal segments. Hypopygium black; its lamellae of moderate size, yellow with black margin, the sides nearly parallel, the apical margin jagged and bristly; lamellae, including the stem, each as long as the fore basitarsus.

Fore coxae yellow, the outer side with a green stripe which is wide at the base, tapering to a point near the apex of coxa; anterior surface with black hairs and the usual black bristles at tip. Middle and hind coxae black with yellow tips. Femora and tibiae yellow, the middle and hind pairs each with a single preapical bristle, the latter not ciliated below. Posterior tibiae slightly thickened near the middle. All tarsi black from the tip of first segment; middle basitarsus without a bristle on upper surface. Joints of fore tarsi as 20-6-5-5-4; of middle tarsi as 22-11-10-5-5; of posterior tarsi as 19-20-12-8-6. Calypters and halteres yellow, the former with black cilia.

Wings grayish, broadest near the middle, the posterior margin somewhat tapering toward the root of wing, yet the anal angle is rather prominent; costa with a conspicuous, elongate, knot-like enlargment at the tip of first vein; last section of fourth vein abruptly bent near the middle, with a conspicuous stump-vein at the posterior angle of the bend; hind margin of wing deeply incised at the tip of fifth vein.

Female. Similar to the male in coloration. The antennae are much smaller than in the male, yet are unusually prominent for a female of this genus; costa without enlargement at tip of first vein; second and third abdominal segments without a cluster of yellow hairs on their sides.

Described from six males and five females, taken in Sunnyside Canyon, Huachuca Mountains, Arizona, July 9, 1940, by D. E. Hardy. Holotype male, allotype female and several paratypes returned to the University of Kansas; paratype male and paratype female in the writer's collection.

Differentia. Dolichopus afflictus Osten Sacken and *D. arizonicus* n. sp. are distinguished from all known members of the genus by possessing a cluster of yellow hairs upon the sides of the second and third abdominal segments. The unusually long, bristly antennae and calypters with black cilia will serve to distinguish *arizonicus* from *afflictus*, since the latter species has calypters with yellow cilia and antennae of ordinary size and structure.

The following key will serve to separate *arizonicus* n. sp. from species with which it might be confused:

1. Cilia of calypters wholly pale yellow 2
   Cilia of calypters black; there may be a few delicate, pale cilia among the large black cilia 3
2. Second and third segments of abdomen each with a cluster of yellow hairs on their sides; antennae of normal size and structure ..... *afflictus* O. S.
   Second and third abdominal segments without a cluster of yellow hairs on their outer sides ..... *crenatus* O. S.
3. Second and third abdominal segments each with a cluster of yellow hairs on their sides ..... *arizonicus* n. sp.
   Second and third abdominal segments without a cluster of yellow hairs on their sides ..... *consanguineus* Whlr.

Dolichopus neomexicanus n. sp.

Male. Length, 5 mm.; length of wing, 4.8 mm. Face wide, densely brownish pollinose. Palpi dark yellow, their outer surface with scattered black hairs. Front dull in color, the greenish-bronze ground color almost wholly obscured by the dense yellowish-gray pollen. First segment of antennae yellow, narrowly blackened on upper edge; second segment black, yellow on inner surface; third segment black, one and one-half times as long as wide, evenly rounded below, pointed at tip. Arista inserted slightly beyond the middle of third segment, pubescent, tapering rapidly. Lateral and inferior postorbital cilia white; about six of the upper cilia on each side are black.

Dorsum of thorax, the pleurae and the abdomen thickly dusted with grayish-white pollen, so that the greenish-bronze ground color is barely perceptible. Hypopygium black; its lamellae of moderate size (without stem, as long as second segment of middle tarsi), somewhat triangular, apical margin narrowly blackened, truncate, jagged and bristly.

Fore coxae concolorous with pleurae, especially on outer surface, the anterior portions and the tip more yellowish; anterior surface of fore coxa covered with small black hairs, and with the usual black bristles at tip; middle and hind coxae concolorous with pleurae, their tips yellowish. Femora and

tibiae yellow; middle and hind femora each with a single preapical bristle, the posterior pair infuscated at tip on upper edge and ciliated on lower apical half with about seven long black hairs, which are slightly curled at the tip and are longer than the width of femora. Posterior tibiae blackened, and slightly incrassated, on apical fourth. Fore tarsi yellow, slightly infuscated from the tip of first segment, the last two segments wholly black; all segments of ordinary structure, not enlarged or compressed. Middle tarsi black from the tip of first segment, the basitarsus with a prominent bristle on upper surface near apical third. Posterior tarsi wholly black, the first segment slightly enlarged. Segments of fore tarsi as 20-12-10-5-5; of middle tarsi as 30-15-11-6-5; of posterior tarsi as 30 (remaining segments missing). Calypters and halteres yellow, the former with black cilia.

Wings grayish, slightly tinged with brown along the costal margin and the veins; costa not enlarged at tip of first vein; last section of fourth vein bent in the form of a right angle slightly beyond the middle, the posterior angle of the bend bearing a prominent stump-vein; anal angle prominent.

Described from one male taken at Cloudcraft, New Mexico, June 28, 1932, by R. H. Beamer. Holotype returned to the University of Kansas.

Differentia. D. neomexicanus n. sp. resembles *D. bifractus* Lw. in general appearance and coloration. The long black cilia along lower inner edge of hind femora in *neomexicanus* differ from *bifractus* in which the posterior femora are eciliate; also *bifractus* has the apical segment of fore tarsi noticeably compressed and fringed with short hairs on upper edge.

Dolichopus hardyi n. sp.

Male. Length, 4.6 mm.; length of wing, 4.5 mm. Face moderately wide, golden pollinose, more silvery on lower portion. Palpi pale yellow, with a small black britsle at tip. Front metallic, blue-green, lightly dusted with white pollen. Antennae yellow; third joint brown on apical half, about as wide as long, bluntly pointed. Arista black, inserted near the middle the third segment. Lateral and inferior postorbital cilia white, the upper cilia black.

Dorsum of thorax metallic, blue-green, very lightly dusted with white pollen; pleurae concolorus with dorsum of thorax, the pollen more dense, the reflections coppery. Abdomen metallic, green with blackish incisures, the lateral portions dulled with white pollen. Hypopygium black; the lamellae twice as long as wide, pale yellow, the apical portion rounded, jagged and bristly, with black margin. Including the stem the lamellae equal the length of middle basitarsus.

Fore and hind coxae yellow, the latter with a brown stripe on outer surface, the former without noticeable hairs on anterior surface, but with the usual black bristles at tip; middle coxae black on outer surface. Femora and tibiae yellow; middle and hind femora each with a single preapical bristle, the latter without cilia along lower, inner edge. First three segments of fore tarsi yellow, the fourth and fifth black; fourth segment preceptibly laterally compressed, the fifth segment more so; empodium white, prominent. Middle tarsi blackened from the tip of first segment, the latter without a bristle on upper surface. Posterior tarsi wholly black. Segments of fore tarsi as 32-21-15-7-7;

of middle tarsi as 33-20-17-9-7; of hind tarsi as 30-31-17-10-8. Halteres, calypters and their cilia, yellow.

Wings grayish hyaline; costa enlarged at tip of first vein; this enlargement tapers gradually, ending two-thirds the distance to tip of second vein; last section of fourth vein bent before its middle, from which point it converges gradually toward the tip of third vein; base of wing tapering but little, the anal angle prominent.

Female. Similar to the male in general coloration. The face is much wider, its pollen silvery; last two segments of fore tarsi not compressed; costa not enlarged at the tip of first vein.

Described from four males and four females. Two males and one female, which include the holotype male and allotype female, were taken at Rustler's Park, Chiricahua Mountains, Arizona, July 5, 1940, by R. H. Beamer; one male and one female taken at Ruidoso, New Mexico, June 26, 1940, by R. H. Beamer; one male and one female taken at Tajique, N. M., June 25, 1940, by D. E. Hardy and one female from Oak Creek Canyon, Arizona, July 9, 1941, by E. L. Todd.

Differentia. D. tener Lw. and *D. celeripes* Van Duzee are two species which might likely be confused with *hardyi* n. sp.; all have the calypters with pale cilia and the antennae more or less yellow. *Tener* is distinct by having long pale cilia along the lower, inner edge of posterior femora; *celeripes* has the third antennal segment wholly black and the segments of fore tarsi unmodified; *hardyi* has the fourth and fifth segments of fore tarsi black and both are noticeably laterally compressed.

Dolichopus silvicolus n. sp.

Male. Length, 4.8 mm.; length of wing, 5 mm. Face as wide as the width of middle femora; yellowish-brown pollinose. Front concolorous with face, with bronze reflections when viewed obliquely. Antennae black; first segment yellowish on lower half; third segment exceptionally long for a member of this genus, equaling the length of second segment of middle tarsi. Arista apical, same length as third antennal segment. Upper postorbital cilia black, the lateral and lower cilia pale.

Dorsum of thorax dulled with yellowish pollen, the reflections bronze-green; pleurae heavily dusted with gray pollen, the greenish-bronze ground color barely perceptible. Abdomen greenish on dorsum, the lateral portions dulled with gray pollen. Hypopygium black; lamellae pale, with broad black margin, the apex is truncate, jagged and bristly.

Coxae concolorous with pleurae; anterior and middle pairs with black hairs on anterior surfaces and black bristles at tip. Anterior femora black, with apical fifth yellow. Middle and posterior femora brown, their upper and lower edges narrowly blackened; middle and posterior femora each with a single preapical bristle, the latter without cilia along lower, inner edge. Tibiae brownish-yellow; posterior pair infuscated at extreme tip. Fore tarsi yellow except the fifth segment which is black and noticeably compressed. Middle tarsi black from the tip of first segment, the basitarsus with a conspicuous bristle on upper surface slightly beyond its middle; posterior tarsi black from the tip of first segment. Comparative length of the fore tarsal segments as

20-10-7-4-4; of middle tarsi as 25-12-8-5-5; of posterior tarsi 20-20-10-7-5. Halteres and calypters yellow, the latter with black cilia.

Wings grayish; the costa is jet black and enlarged at the tip of first vein; this enlargement tapers gradually and ends at the tip of second vein; fourth vein bent upward at a right angle near its basal third, the posterior angle bearing a prominent stump-vein; anal angle evenly rounded, the anal angle prominent.

Described from two males taken at Cloudcroft, New Mexico, June 27, 1940, by R. H. Beamer.

Differentia. The unusually long third antennal segment, with its apical arista, the laterally compressed fifth segment of fore tarsi and the prominent, enlarged costa will readily distinguish *D. silvicolus* n. sp. from other members of the genus.

Chrysotus intrudus n. sp.

Male. Length, 2.5 mm.; length of wing, 2.2 mm. Face silvery pollinose, the dull greenish-bronze ground color perceptible on upper portion, wide at the insertion of antennae, tapering abruptly on lower portion so that the eyes are barely separated. Front metallic, green, lightly dusted with silvery pollen. Palpi black, their anterior surface with white pollen, so that when viewed obliquely they appear concolorous with the face, each with conspicuous black bristle near the tip. Lateral and inferior postorbital cilia white. Antennae black; third segment twice as long as its width at base, elongate-triangular, rounded at tip, densely pilose. Arista apical, pubescent, slightly longer than the third segment.

Dorsum of thorax green, metallic, lightly grayish pollinose, with a median coppery line that extends caudad to a point even with the root of wings; pleurae dull, metallic green, its pollen more dense than upon the dorsum. Abdomen green, metallic, its hairs and bristles, and those of the thorax, black. Hypopygium black, embedded; lamellae brown, about the length of apical segment of middle tarsi, blunt at tip, the posterior surface with brown cilia.

Coxae concolorous with pleurae, the anterior surfaces with black hairs. Femora blackish-green, metallic; posterior pair somewhat thickened near the middle, with three prominent bristles near the tip on lower edge. Tibiae yellow, the posterior pair brownish on apical third; fore and middle tibiae with a prominent bristle on anterior surface near basal fourth, the latter also with two bristles near middle; posterior tibiae with five or six prominent bristles on posterior surface. Tarsi blackened from the tip of first segment, all of plain structure. Segments of fore tarsi as 20-7-6-4-4; of middle tarsi as 25-8-7-6-5; of posterior tarsi as 17-14-8-7-6. Calypters, their cilia and the halteres, yellow.

Wings grayish hyaline, veins black; third and fourth veins parallel from slightly beyond the cross-vein; fourth vein ending in apex of wing; cross-vein at center of fifth vein; anal angle evenly rounded, prominent.

Female. Similar to the male in coloration. Face wider than in the male, its width equaling that of posterior femora; third antennal segment reniform, not elongate, the upper edge extending back over the second segment to near the base of the latter; arista apical, inserted slightly below the middle of third segment.

Described from five males and 1 female. Three males and one female, which include the holotype male and allotype female, were taken at Commerce, Oklahoma, May 16, 1940 by R. H. Beamer; one male and one female were taken in Cherokee County, Kansas, May 15, 1940 by R. H. Beamer. Labels of the latter two specimens bear the additional information "Father B's place".

Asyndetus spinitarsis n. sp.

Male. Length, 2.8 mm.; length of wing, 2.5 mm. Face and front silvery pollinose, the former but slightly narrower than the front, its width equaling the width of base of fore femora, the sides parallel. Palpi yellowish-brown, bearing two conspicuous black bristles on upper surface, near the tip. Lateral and inferior postorbital cilia pale. Antennae black; third segment very short, approximately the same length as first segment, its tip truncate. Arista dorsal, same length as first segment of middle tarsi.

Dorsum of thorax and the pleurae densely grayish pollinose, the greenish-bronze ground color barely perceptible. Abdomen metallic, greenish-bronze; hairs on dorsum and venter, and the four prominent bristles at tip of abdomen, black. Hypopygium small, wholly embedded, with no apparent external appendages. Halteres and calypters yellow, the latter with white cilia.

Coxae concolorous with pleurae, the anterior surfaces of fore and middle pairs with black hairs and bristles. Trochanters brownish-yellow. Femora black, with blue reflections, metallic; posterior surface and lower edge of fore femora with prominent black, hair-like bristles which are nearly as long as the diameter of femora. Middle femora narrowed on basal one-fourth, from which it is abruptly enlarged then tapers gradually to apex. At its widest point the femora bears a prominent black bristle on lower edge; the bristle equals the length of first segment of fore tarsi and is bent backward at its apical third. Posterior femora without noticeable bristles. Fore and middle tibiae yellow, the former without noticeable bristles, the latter with six evenly-spaced black bristles on upper edge; posterior tibiae narrowly brownish-yellow along upper and lower edges, the inner and outer surfaces black, the tip with a prominent black bristle on upper edge. Fore and middle tarsi yellow, darkened from the tip of first segment, without noticeable hairs. Posterior tarsi black; first segment as long as the combined length of second and third segments; second and fifth segments of equal length; third and fourth segments short, the latter almost orbicular, both bearing numerous long, crinkly hairs on lower surface; the fourth segment bears also a prominent black bristle at tip on lower edge; fifth segment narrow, glabrous. Length of fore tarsal segments as 10-4-4-2-2; of middle tarsi as 12-6-4-3-3; of posterior tarsi as 8-5-3-4-5.

Wings grayish hyaline; veins yellow near the base of wing, otherwise black; costa ending at tip of third vein; the latter runs near the second vein and terminates well before the tip of wing; fourth vein delicate but complete throughout, its apical one-fourth bends downward and ends behind the tip of the wing; posterior cross-vein near the base of wing.

Described from one male taken at Palm City, California, July 19, 1940 by R. H. Beamer.

Differentia. The prominent black bristle, bent backward at a right angle, situated near the basal third of middle femora, and the presence of long,

crinkly hairs on the lower surfaces of third and fourth segments of posterior tarsi, will at once distinguish *A. spinitarsis* n. sp. from all the known members of the genus.

Chrysotimus occidentalis n. sp.

Male. Length, 1.5 mm.; length of wing, 1.7 mm. Face as wide as middle femur, silvery pollinose. Front densely silvery pollinose, the pale greenish ground color barely perceptible. Antennae wholly yellow; third joint not at all infuscated, densely pubescent, slightly broader than long. Arista brown, dorsal. Orbital cilia and all bristles of the head, yellow. Palpi yellow, pubescent, lightly silvery pollinose.

Thorax, including the pleurae, abdomen, coxae and legs, wholly yellow. The flattened area on posterior portion of thorax, before the scutellum, has a somewhat silvery appearance when viewed from behind; the apical segment of all tarsi, the inner appendages of the hypopygium and the extreme basal portions of the abdominal segments are noticeably infuscated. Outer hypopygial lamellae short, slightly longer than apical segment of fore tarsi, tapering to a point, the margins with delicate, pale cilia. Calypters and halteres yellow, the former with pale yellow cilia. Segments of fore tarsi as 20-9-7-4-4; of middle tarsi as 25-10-8-4-4; of posterior tarsi as 18-16-8-4-4.

Wings grayish hyaline, tinged with yellow; veins pale yellow; third and fourth veins nearly parallel beyond the cross-vein, the latter situated slightly beyond the middle of fifth vein; anterior and posterior margins of wing nearly parallel, the anal angle prominent, evenly rounded.

Described from 25 males and 17 females, taken in Sunnyside Canyon, Huachuca Mountains, Arizona, July 9, 1940. Seventeen males and 14 females, which include the holotype male and allotype female, were collected by D. E. Hardy; 2 males and four females were taken by L. J. Lipovsky and 5 males were taken by E. E. Kenaga.

Differentia. The wholly luteous coloration, except for infuscation of last tarsal segments, will readily distinguish *C. occidentalis* n. sp. from other members of the genus occurring in North America.

A NEW HYDROMETRA FROM MAURITIUS

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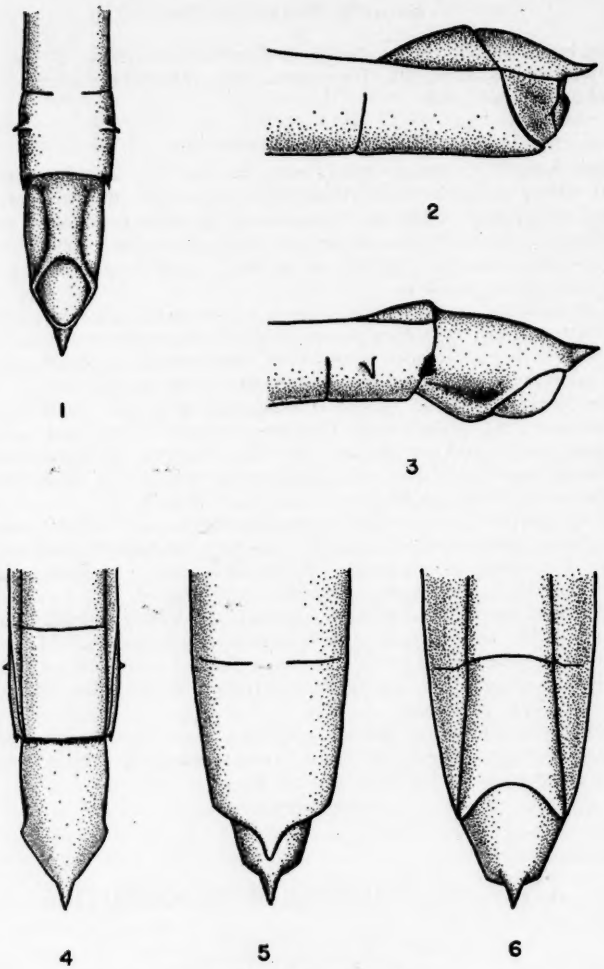
Hydrometra mameti new species

Size and color: Length 9.66 mm. (male); 10.9 (female). The general color is reddish brown and black. The head dark brown to nearly black, its base brown; pronotum reddish brown with a median longitudinal dark brown to nearly black band containing a row of silvery pits, lateral margin dark with a frosty line above the base of the anterior acetabula which with the other acetabula are more or less frosted. Abdominal tergites except the last one,



Hydrometra mameti n. sp.

PLATE I

Hydrometra mameti Hungerford

Drawings of terminal abdominal and genital segments.

1. Male—Ventral view.
2. Female—lateral view.
3. Male—lateral view.
4. Male—dorsal view.
5. Female—ventral view.
6. Female—dorsal view.

shining, mahogany brown to black, the connexivum reddish brown with a silvery basal spot on each segment. Venter more or less frosted, each abdominal segment with a lateral, basal silvery spot.

Structural characteristics:

Head: Length 100 units; the ratio of the anteocular part of the head to the postocular part is given by the formula AO:PO::63:30. The dorsal interocular groove less than the diameter of the eye. The clypeus is quadrate, straight to slightly emarginate in front, its median length about five sevenths its width, rostrum attaining three fifths of the postocular distance. The antennal segments: 1:2:3:4::20:37:103:57.

Pronotum: Length 52 units*; pits moderately deep and usually marked by a silvery spot in the depression. They are arranged as follows: one transverse row behind the anterior margin, the anterior lobe otherwise devoid of pits although the median line is depressed slightly and often silvery. The posterior lobe, with median conspicuous row, a less obvious row at each margin of the median dark band and another row near the lateral margin of the pronotum.

Coxae: The distance between the first and second coxae is to that between the second and third as 30:56. The anterior and middle acetabula have two pits on each side of the cleft, the posterior acetabula unpitted.

Femora: The anterior femora surpass the head by half the length of the first antennal segment. The hind femora reach the tip of the abdomen in the female and surpass it in the male.

Abdomen: The last ventral abdominal segment of the male with two widely spaced projections as shown in figure 1 of plate I. The caudo-lateral margins with tufts of stout bristles. The first genital segment of the male with a very broad keel. The female abdomen as shown in plate I. All the specimens are brachypterous, the wing pads brown and of uneven surface and surpass the two basal abdominal tergites in the male and are shorter in the female.

Comparative notes: I know of no species that is very close to this new one. The male abdominal segments are somewhat like those of *H. bifurcata* H. and E. but the clypeus is very different, being truncate and not bifurcate.

Location of types: Described from four males and three females from the island of Mauritius collected by Ray. Mamet, in whose honour the species is named. The holotype male, allotype and three paratypes in the Francis Huntington Snow Collection, University of Kansas, two paratypes in Ray. Mamet's collection in Mauritius.

* unit=.033 mm.

GRASSHOPPER TOXINS: A COMPARISON OF ELEVEN MATERIALS

CHARLES H. BRETT, MILLEDGE MURPHEY, JR., and REX B. REINKING[1]

Tests reported herein are part of a series conducted for the purpose of identifying, in the laboratory, toxins which might be worth field-scale testing. Such analyses also make it possible to better understand the nature of toxins in their effect on grasshoppers. Chemicals were selected from commercial sources and from untried laboratory preparations which had formulae suggesting insecticidal value. Dr. Ernest M. Hodnett and Dr. Sylvan R. Wood of the Oklahoma Agricultural and Mechanical College Chemistry Department supplied most of the latter.

Methods

Grasshoppers used in the tests were fourth, fifth and sixth instars of the differential grasshoppers, *Melanoplus differentialis* Thomas, collected from the field and confined in screen cages.

Feeding tests were made by dipping fresh alfalfa leaves into chemical concentrations of different levels. The leaves thus uniformally treated were dried and placed in approximately equal amounts in screened cages one cubic foot in volume and containing 25 grasshoppers. Each treatment was replicated from 2 to 14 times. The number of dead grasshoppers was determined at regular time intervals.

Contact toxicity of the chemicals was measured in two different ways. By one method, the grasshoppers to be treated were placed in a two quart mason jar. Fifty milligrams of dust containing a certain concentration of the chemical was administered in a single puff. After five minutes the grasshoppers were removed, placed in a cage, and fed untreated fresh alfalfa leaves. By another method, the abdomens of the grasshoppers were dipped into the chemicals. The grasshoppers were then placed in cages and fed fresh alfalfa leaves. Each treatment was replicated at least twice and readings made as described for the feeding tests.

Poisoned bran bait tests were made with both dry and damp baits. An excess of the bait was always available to the caged grasshoppers. Fresh, untreated alfalfa leaves were supplied as an alternate.

Field applications were made using Stearman planes with the front cockpit replaced by a spraying unit. The booms ran through the wings and had vertical nozzles about eighteen inches apart. The fifty-foot spray swaths were overlapped about eight feet, insuring fairly even coverage. Approximately 95 percent of the grasshoppers sprayed by plane were last instar and adult *M. differentialis*. Applications were made at dawn while the air was quiet.

Materials tested and results.

Chlordane has been generally recommended for grasshopper control. It was used in this series largely as a standard of comparison. Greater velocity

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of mortality occurred when the grasshoppers fed upon treated plants than when they were killed by external contact. However, the insecticide was effective in all instances, as can be seen in table 1.

Aldrin has been established as a good insecticide for grasshopper control and is now generally approved for use. Table 1 shows 0.25 percent aldrin to have about the same toxicity as 1.0 per chlordane when grasshoppers were fed treated alfalfa leaves. As with chlordane, the velocity of mortality was greater when grasshoppers fed on treated leaves than when the insecticide was applied to their body surfaces.

Dieldrin was comparable to aldrin except that it affected and killed the grasshoppers a little faster and appeared to be more toxic, particularly as a contact poison. It was noted in tests with several materials that nymphs which molted shortly after being treated externally with the toxins often survived.

Dilan is the trade name of an insecticide containing one part of 2-nitro-1, 1-bis(p-chlorophenyl) propane and two parts of 2-nitro-1, 1 bis(p-chlorophenyl)-butane. This material acted both as an internal and external poison, but was considerably less toxic than chlordane. Table 1 indicates the concentration would need to be four or more times that of chlordane in order to equal it as a grasshopper toxicant.

Chloral hydrate is commonly called "knock out drops" and is an intermediate in the manufacture of DDT. It had a low level toxicity to the grasshoppers and was more effective when taken internally than when applied externally.

A phosphonium halide of the general type R_4PCl was prepared by the action of phosphine on formaldehyde in the presence of hydrochloric acid. This compound was supplied by Dr. Sylvan Wood of the Chemistry Department. It appeared to make the alfalfa leaves somewhat unpalatable to the grasshoppers. Probably for this reason it was considerably more effective as an external contact poison. Toxicity was of a low level.

An ammoniated phosphonium halide was prepared by Dr. Wood. It contained about 6.75 percent nitrogen in addition to the phosphorus and chlorine. Toxicity was increased, but was still at a low level. This compound was also somewhat unpalatable to the grasshoppers.

Unsymmetrical heptachloropropane with the formula $CCl_3CCl_2CHCl_2$ was supplied by Dr. Ernest Hodnett. This chlorinated hydrocarbon was somewhat unpalatable and showed about the same toxicity as the phosphonium halide.

Hexachloropropene with the formula $CCl_3CCl{=}CCl_2$ is a chlorinated unsaturated hydrocarbon which was supplied by Dr. Hodnett. It showed less toxicity to the grasshoppers than heptachloropropane.

It appears that the last four compounds listed would need to be concentrated to ten or more times that of chlordane in order to equal it in effectiveness.

Chlordane bran bait tested was prepared by the U.S.D.A. with the following formula: one-half pound technical chlordane, one-half gallon kerosene, and 100 pounds of bran. It was quite palatable to the grasshoppers and was selected readily, even though fresh alfalfa leaves were always present as an

TABLE 1. *Grasshopper toxins; a comparison of eleven materials and four methods of application.*

Material Tested	Concentration (percent)	Method of Application	Percent Mortality (hours) 4	8	24	48	72
Chlordane	1.0	Feeding on dipped alfalfa	18	76	93	98	99
	2.0	Feeding on dipped alfalfa	29	84	100	100	100
	2.0	Dipped abdomen	0	0	40	100	100
	2.0	Dusted on grasshopper	0	0	15	100	100
Aldrin	0.06	Feeding on dipped alfalfa	2	66	90	96	98
	0.12	Feeding on dipped alfalfa	8	62	96	98	100
	0.25	Feeding on dipped alfalfa	18	58	86	94	98
	0.25	Dipped abdomen	0	0	10	75	90
Dieldrin	0.06	Feeding on dipped alfalfa	8	74	90	96	98
	0.12	Feeding on dipped alfalfa	10	60	84	96	98
	0.25	Feeding on dipped alfalfa	32	80	92	96	96
	0.25	Dipped abdomen	0	0	20	100	100
Dilan	0.25	Feeding on dipped alfalfa	0	0	12	22	38
	5.0	Dusted on grasshopper	0	0	40	85	85

Chloral hydrate	5.0	Feeding on dipped alfalfa	0	0	2	14	26
	5.0	Dipped abdomen	0	0	0	10	10
A phosphonium halide	2.0	Feeding on dipped alfalfa	0	0	0	5	9
	3.0	Feeding on dipped alfalfa	0	0	0	0	4
	5.0	Dipped abdomen	0	0	5	35	35
An ammoniated phosphonium halide	2.0	Dusted on grasshopper	0	0	0	5	10
	5.0	Feeding on dipped alfalfa	0	2	14	30	40
Unsymmetrical heptachloropropane	5.0	Feeding on dipped alfalfa	0	0	0	4	4
	5.0	Dusted on grasshopper	0	0	25	35	35
Hexachloropropene	5.0	Feeding on dipped alfalfa	0	0	0	0	12
	5.0	Dusted on grasshopper	0	5	10	20	20
Chlordane bran bait	0.5	Dry bait	16	51	68	98	99
	0.5	Damp bait	14	86	98	100	100
Toxaphene bran bait	1.0	Dry bait	2	43	82	90	98
	1.0	Damp bait	6	54	92	94	96

alternate. Damp bait was preferred to dry bait. This increased the velocity of mortality, but made no difference in final effectiveness.

Toxaphene bran bait was also prepared by the U.S.D.A. It was formulated as follows: one pound technical toxaphene, one-half gallon kerosene, one hundred pounds bran. This was as effective as the chlordane bait, but initial velocity mortality was lower. Again, the damp bait was eaten more readily by the grasshoppers than was the dry bait, but there was no difference in final effectiveness.

Results with Airplane Application in the Field.

A 16-acre alfalfa field infested at a level of about 200 grasshoppers per square yard was sprayed with toxaphene emulsion at the rate of two pounds of actual toxaphene per acre. This was in two gallons of emulsion. Most grasshoppers were nymphs and adults of the differential species. Application was made at 4:00 a.m. The sky was cloudy and the air still. Four days later, the field was checked carefully and it was estimated there were ten to fifteen live grasshoppers per square yard.

Another field with an infestation of about 100 grasshoppers per square yard was sprayed in the same manner except that aldrin emulsion was used. This was applied at the rate of one-fourth pound of aldrin per acre. Three days later, it was estimated that 85 percent to 90 percent of the grasshoppers were dead and some were still dying.

Summary.

Chlordane was used as a standard for comparing the toxicity to grasshoppers of eleven materials. Tests were designed to show internal and external effectiveness of the toxins on the basis of velocity of mortality. Airplane applications were made in the field with toxaphene and aldrin.

Dieldrin and aldrin showed a toxic level equal to chlordane when their concentration was one-fourth or less. Dieldrin was more toxic than aldrin. All were effective as internal and external toxins.

Dilan was considerably less toxic than chlordane. Chloral hydrate showed a low level of toxicity. Two phosphonium halides and two chlorinated hydrocarbons showed a low level of toxicity and were somewhat unpalatable to the grasshoppers.

Two pounds of actual Toxaphene in two gallons of emulsion per acre sprayed by an airplane, and four ounces of aldrin in two gallons of emulsion applied in the same manner in the field, each killed about 90 percent of infestations of differential grasshopper nymphs and adults within a period of three to four days.

A REVIEW OF THE GENUS KELISIA IN AMERICA NORTH OF MEXICO WITH FOUR NEW SPECIES (Homoptera-Fulgoridae-Delphacinae)

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Key to the Species

1. Elytra with a brown or black, longitudinal stripe of regular width from base to tip 2
   Elytra without such a stripe 7
2. Dark mark of elytra continued across front ..... *flagellata*
   Dark mark of elytra not continued across front 3
3. Black spot on front beneath each ocellus and one on lateral margin of pronotum above coxae ..... *pectinata*
   Usually without black spot in either of these positions 4
4. Stripe on elytra very broad, occupying two-thirds area ..... *spinosa*
   Stripe narrow, occupying about one-third area 5
5. Stripe on elytra very light amber except at tip ..... *torquata* n. sp.
   Stripe very much darker 6
6. Elytra of short wing form barely passing abdomen, median stripe light ..... *parvicurvata* n. sp.
   Elytra with almost one-third their length beyond abdomen, median stripe dark ..... *curvata*
7. Elytra without black marks ..... *flava* n. sp.
   Elytra with black marks 8
8. Black spot beneath each ocellus and on lateral margin of pronotum above front coxae ..... *bimaculata*
   Without such black spots 9
9. Black markings of elytra confined to a spot in apex of elytra 10
   Black markings of elytra heavy at apex and base, usually narrowly following second sector ..... *axialis*
10. Dark stripe on either side of abdomen continued over pronotum ..... *retrorsa*
    Dark stripe on either side of abdomen usually not continued over pronotum 11
11. Genital capsule of male almost black ..... *vesiculata* n. sp.
    Genital capsule of male stramineous ..... *hyalina*

Kelisia axialis VanD.

This interesting species was described from one pair taken at Lancaster, New York in 1886. This range is extended to include the following localities by specimens in the Snow Entomological Collections: Brule, Wis.; Spring-

* Contribution No. 758 from the Department of Entomology, University of Kansas, Lawrence.

field, Vt.; Danbury, N. H.; Durham, N. H.; Stroudsburg, Pa.; Pecks Pond, Pa.; Bergen, N. Y.; and Mountain Lake, Va. All of these specimens were macropterous and were taken in August and September.

Kelisia bimaculata Beamer

A nice series of both sexes of this species was taken at New Canaan, N. H., in August. All specimens are brachypterous as are the types.

Kelisia curvata Beamer

The range of this beautiful little dark-lined species is here extended as follows; Dallas, Texas, Dec. 5, 1945; Old Ocean, Texas, Jan. 3, 1946; Chapel Hill, N. C., Aug. 31, 1946; Gainesville, Fla., Dec. 25, 1950.

Kelisia pectinata Beamer

Additional specimens of this species have been taken in Tinley Park and Paxton, Ill., July, 1946.

Kelisia retrorsa Beamer

The range of this species has been increased by material from the following localities: Canaan, N. H.; Colchester, Conn.; Storrs, Conn.; and Dingmans Ferry, Pa. All were taken in August, 1946.

Kelisia spinosa Beamer

Additional material of this species has been added from the following localities: Pactola, S. D.; and Dingmans Ferry, Pa.

1. *Kelisia torquata* n. sp.

Brachypterous form:

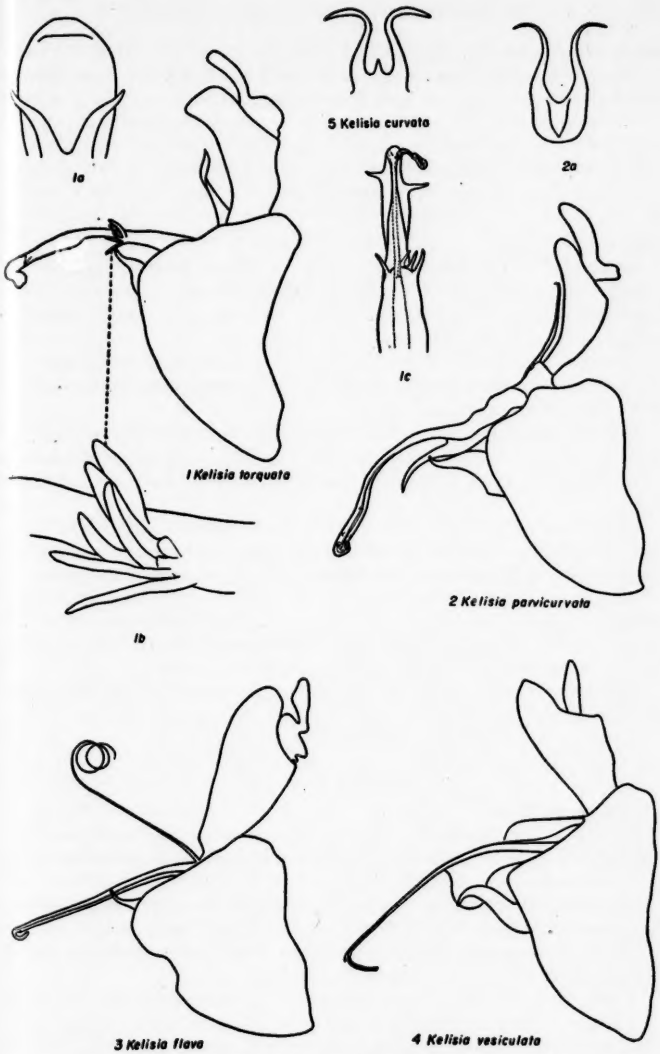
Resembling *Kelisia curvata* Beamer but longitudinal dark stripe on elytra very light, process near middle of aedeagus with many divisions instead of a single process and lyre-shaped anal segment processes without a median basal tooth in caudal view. Length ♂ 3 mm., ♀ 3.2 mm.

Structure: Elytra widest just before base, tapering to pointed apices, more so on mesal margins, extending about one-seventh their length beyond tip of abdomen. Hind wings reduced to tiny pads.

Color: General color stramineous with a very light amber colored stripe from hind margin of eye to tip of elytra where it is usually darker, stripe usually not covering more than one-third area of elytra; body usually without definite dark markings.

Genitalia: Pygofer of male in lateral view more or less triangular, posterior angle broadly rounded, basal angles somewhat sharper; anal segment with posterior margins truncate, less than half as long as inner margin with a basal pair of processes widest at base, lyre-shaped in caudal view without a median tooth; aedeagus long and broader than normal for the genus with a basal ventral process which ends just before middle of shaft in a number of finger-like processes, the number variable; apex of shaft more or less twisted with a sharp tooth on either side before tip not bilaterally symmetrical.

Holotype ♂, 5 ♂ and 16 ♀ paratypes, Storrs, Conn., August, 1946, R. H. Beamer.



EXPLANATION OF PLATE

1. *Kelisia torquata* lateral view of genital capsule; 1a caudal view of processes on anal segment; 1b enlargement of processes near middle of aedeagus; 1c dorsoventral view of aedeagus enlarged.
2. *Kelisia parvicurvata* lateral view of genital capsule; 2a caudal view of processes on anal segment.
3. *Kelisia flava* lateral view of genital capsule.
4. *Kelisia vesiculata* lateral view of genital capsule.
5. *Kelisia curvata* caudal view of processes on anal segment.

Macropterous form:

Like the brachypterous form but brown line on sides of thorax darker, with flight wings about one-third longer than abdomen. Length ♂ 4.5 mm.

Holomorphotype ♂ and 1 ♂ paramorphotype Storrs, Conn., August, 1946, R. H. Beamer.

Types in Snow Entomological Collections.

2. *Kelisia parvicurvata* n. sp.

Brachypterous form:

Resembles *Kelisia curvata* Beamer but definitely smaller, median longitudinal stripe on elytra much less dense, median process on venter of aedeagus longer and without a sharp demarcation between the apical and basal portion. Length ♂ 2.2 mm., ♀ 2.5 mm.

Structure: Elytra widest at tip of scutellum, tapering to evenly sharpened apices, barely reaching beyond tip of abdomen; hind wings reduced to tiny pads about half as large as an eye.

Color: General color stramineous to almost white; light brown stripe from back of eye to tip of elytra where it is darker, stripe occupies slightly less than one-third area of elytra; body with some slightly dusky areas along lateral margins.

Genitalia: Male pygofer in lateral view more or less triangular with caudal angle broadly rounded and toward dorsal margin; posterior margin of anal segment broadly rounded and less than one-fourth as long as anterior or dorsal margin; lyre-shaped processes in caudal view narrow, not half as long as aedeagus, with tips turned out, without median tooth in caudal view; aedeagus long and slender with an elongated process on ventral side of basal third which is not deeply incised on its ventral side near middle.

Holotype ♂, allotype ♀, 1 ♂ and 6 ♀ paratypes, Palatka, Fla., March 10, 1947, R. H. Beamer.

Types in the Snow Entomological Collections.

3. *Kelisia flava* n. sp.

Brachypterous form:

Resembles *Kelisia flagellata* Beamer in internal male genitalia but has no dark color at all on the elytra and the elytra are longer and more pointed without branches in apices. Length ♂ 2.9 mm., ♀ 3.2 mm.

Structure: Elytra widest near basal third, extending beyond abdomen less than one-fourth their length; hind wings tiny pads less than half size of an eye. External parts of genital capsule quite thickly covered with rather long white hairs, much more so than in *K. flagellata.*

Color: General color light stramineous without fumose color anywhere.

Genitalia: Male pygofer in lateral view more or less triangular, caudal angle broadly rounded; anal segment with a pair of long whip-like basal processes; aedeagus long, rather broad with a pair of lateral teeth just before apex.

Holotype ♂, allotype ♀, 97 ♂ and 57 ♀ paratypes, Danbury, N. H., August 8, 1946, R. H. Beamer; other specimens at hand: 1 pair Durham, N. H.; 1 pair Colchester, Conn.; 87 ♂ s and 2 ♀ s Lake Placid, N. Y.; 32 ♂ s and

4 ♀s Paul Smith, N. Y.; 2 ♂s and 4 ♀s Numidia, Pa., 12 ♂s and 12 ♀s Ashland, Pa., 8 ♂s and 10 ♀s Chapel Hill, N. C., all in August, 1946, R. H. Beamer.

Macropterous form:

Resembling the brachypterous form but larger and with flight wings extending almost one-third their length beyond the abdomen. Length ♀ 4 mm.

Holomorphotype ♀ and 4 ♀ paramorphotypes, Lake Placid, N. Y., July 30, 1946, R. H. Beamer.

Types in the Snow Entomological Collections.

4. *Kelisia vesiculata* n. sp.

Brachypterous form:

Resembling *Kelisia hyalina* Beamer but genital capsule almost black in color, aedeagus straight in lateral view with median ventral process enlarged and flattened laterally on outer half instead of hooked. Length ♂ 3.2 mm., ♀ 3.4 mm.

Structure: Elytra widest on basal third, slightly narrowed to rounded apices, extending about one-fifth their length beyond abdomen; hind wings reduced to mere pads less than half as large as an eye. Male pygofer quite hairy.

Color: General color dark stramineous with narrow white median longitudinal stripe on pronotum, elytra almost hyaline with a small black more or less angular black spot on apices. Male pygofer almost black, various darkened areas over abdomen.

Genitalia: Pygofer of male in lateral view more or less triangular, ventral corner broadest, caudal angle about a right angle; processes at base of anal segment about half as long as aedeagal shaft, almost straight, quite narrow; aedeagus straight, widest at base, narrowed to twisted apex, median ventral process about half as long as shaft, enlarged to a large lobe apically, laterally flattened.

Holotype ♂, allotype ♀, 44 ♂ and 26 ♀ paratypes, Storrs, Conn., August, 1946, R. H. Beamer.

Macropterous form:

Like the brachypterous form except body generally darker, flight wings present, extending about one-third their length beyond the body with usually a dark spot between the branches of the second sector.

Holomorphotype ♂, allomorphotype ♀, 46 ♂ and 20 ♀ paramorphotypes, Storrs, Conn., August, 1946, R. H. Beamer.

Types in the Snow Entomological Collections.

GREEN JUNE BEETLE DAMAGE TO FALL PASTURE

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Green June beetle injury to entire fields is relatively rare, according to published accounts. Such an infestation was recently observed, however, in recently seeded pasture in Northwestern Arkansas. Apparently it was brought about by enthusiastic use of soil improvement practices.

The larval stage of this insect feeds on decomposing organic matter in the soil, and is ordinarily associated with such restricted situations as manure piles and hay-stacks. Lawns or golf greens may be infested where heavy applications of organic matter are made, and tobacco plant beds are frequently infested following the customary heavy application of manure or plant litter.

A ten-acre field of mixed oats and rye grass near Fayetteville, Arkansas, was severely damaged by this insect in the fall of 1949. A regular practice of heavy manuring had been followed for several years on this farm in an effort to bring the soil to a high productive level. Manure from a broiler chicken project and from a herd of dairy cattle had been utilized, as well as some additional manure from neighboring farms.

Heavy applications of manure were made to the field in question and partially disced in during the spring of 1949. Later in the summer the field was planted to a mixture of rye grass and oats to be used as fall pasture. In the fall, when the stand was only 3 or 4 inches high, a heavy infestation of green June beetle larvae was found and the crop appeared in serious danger. Evidently there was little if any direct feeding on roots, but the extensive working of the soil by the insects uprooted many seedlings and dried out the surface soil so that other seedlings died from soil dryness. Both the rye grass and the oats were affected, but the rye grass was injured to a greater extent due to its smaller root system at the time.

All fields on the farm were found to be rather uniformly infested, but not to the extent of the field which had received the application of manure a few weeks previous to the adult flight in early July. Accurate infestation counts were not possible, but an indication of the severity of the infestation is found in the fact that in an adjoining permanent pasture more than 100 fresh burrows could be found in an area of 400 square feet, and in an experimental plot 239 dead larvae were found in an area of 100 square feet.

The stand of fall pasture was damaged considerably, but rains and favorable growing weather followed and those plants which had not been killed outright began to make rapid growth. Arrival of cool fall weather slowed the activities of the larvae at the same time, allowing the stand to make a recovery. The rye grass was practically all killed, but the oats produced a good crop. If the injury had occurred earlier in the seedling stage, however, the loss to both crops could easily have been total.

Experiments on control measures were conducted in a permanent pasture

* Research paper No. 932, Journal Series, University of Arkansas. Published with the permission of the director of the Arkansas Agricultural Experiment Station.

adjacent to the oats. Here plots twenty feet square were laid out and one plot each received the following treatments:

A. Poisoned bran bait, 100 lbs. dry basis per acre. (4 lbs. Paris green, 100 lbs. wheat bran, water to form proper consistency)
B. 5% chlordane dust, 5 lbs. actual chlordane per acre.
C. 5% Benzene hexachloride dust, 5 lbs. gamma per acre.
D. Untreated check.

A pre-treatment count of visible burrows indicated approximately equal infestation throughout the plot layout. All applications were made the evening of October 12, which was cool with a moderate breeze. Insecticides were merely distributed on the soil surface and not worked in, since there was considerable working of soil by the larvae themselves and since larvae often feed on the surface.

Plots were inspected one week after treatment. Many dead larvae were found on the surface, and these coincided closely with the plot boundaries. A count of dead larvae was therefore made as an estimate of effectiveness of the treatments. A space ten feet by ten feet square in the center of each plot was used. The number of dead larvae for each treatment was as follows:

Check, 0
Bran bait, 4
Chlordane, 4
Benzene hexachloride, 239

From the stage of decomposition of the larvae it was evident that the kill had started soon after application and was continuing at the time counts were made.

Three and one-half weeks after treatment, when activity by the insects had slowed considerably, the plots were inspected again. The bait plot had approximately as many fresh burrows as the check. In the chlordane plot there were appreciably fewer burrows than in the check, although no dead larvae were found. In the benzene hexachloride plot there were practically no burrows at all. Very few dead larvae remained on the plot at this time, but to the south and west of the BHC plot freshly dead larvae were found in abundance. There was some drift in these directions during the application, and it is believed that the light dosage thus given to these areas resulted in a slow but rather good kill.

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